reduce the association of oxygen with the conductive layer during formation of the other layer or layers. By reducing the amount of oxygen associated with the conductive layer, the electrical characteristics of a semiconductor device including the conductive layer are improved, as will be discussed in more detail below with reference to the disclosed embodiments of the invention. In order to help the Examiner appreciate certain distinctions between the pending claims and the subject matter of the applied reference, the disclosed embodiments of the invention will now be discussed in comparison to the applied reference. Specific distinctions between the pending claims and the applied references will be discussed after the discussion of the disclosed embodiments and the applied reference. This discussion of the differences between the disclosed embodiments and applied reference does not define the scope or interpretation of any of the claims.

One embodiment of the present invention is discussed with reference to Figures 7-10 in which an interposing layer 52 such as a tungsten nitride layer 52 is formed between a conductive plug 46 formed in a via 44 and a conductive line material 48 formed in a trench or container 50. The tungsten nitride layer 52 enhances the electrical contact between the line material 48 and the plug 46, promotes adhesion of the line material within the container 50, prevents or slows the diffusion of materials across the tungsten nitride layer boundary, or serves some other purpose. As previously described, the tungsten nitride layer 52 may associate with oxygen after it is formed and subsequent thermal processes may result in the formation of an oxide layer 54 formed between the tungsten nitride layer 52 and the line material 48. Because the oxide layer 54 is an insulator, this layer will adversely affect the electrical connection between the line material 48 and the plug 46.

By exposing the tungsten nitride layer 52 to an oxygen-inhibiting agent or a reducing atmosphere prior to formation of the line material 48, the thickness of the oxide layer 54 is reduced to a thickness of less than 10 angstroms or entirely eliminated as illustrated respectively in Figures 9 and 10. In this way, the conductive tungsten nitride layer 52 is exposed to an oxygen-inhibiting agent or reducing atmosphere prior to the line material 48 being formed on the conductive tungsten nitride layer to thereby reduce an ability of the conductive tungsten nitride layer to associate with oxygen. As described in the specification, the tungsten nitride layer 52 or other conductive layer may be treated in a plasma such as an N_2 and H_2 plasma, an NH_3 plasma, or an N_2 plasma. See page 6, lines 13-30 and page 7, lines 1-19. Furthermore, the

conductive layer may be treated in a nitrogen-free gas, such as a plasma treatment including H_2, or may be treated with other materials such as diborane B_2H_6, phosphine PH_3, methylsilane CH_3SiH_3, hexamethyldisilane $(CH_3)_3Si\text{-}Si(CH_3)_3$, hexamethyldisilazane HMDS, carbon tetrafluoride CF_4, CHF_3, HCL, boron trichloride BCl_3, and silane SiH_4, and any combinations of these materials, as described on page 7, lines25-30, page 8, lines 1-16, and page 9, lines 1-12.

Returning now to the claim rejections, the present patent application is a divisional of U.S. Application No. 09/200,253 filed on 25 November 1998 and now issued as U.S. Patent No. 6,303,972. As a result, the priority date of the present application is 25 November 1998. The filing date of Chien patent is 21 June 1999, which is the date of the patent as a prior art reference under Section 102(e). Because the priority date of the present application of 25 November 1998 is prior to the filing date of 21 June 1999 of the Chien patent, the Chien patent may not be applied as prior art against the present patent application under Section 102(e) or any other paragraph of Section 102.

Amended claim 73 recited an in-process device including a substrate and a conductive layer over the substrate. The conductive layer is exposed to a material selected from the group consisting of diborane, phosphine, and a carbon-silicon compound to reduce an ability of the conductive layer to associate with oxygen. None of the references of record, whether taken singly or in combination and including the Chien reference, discloses or suggests exposing a conductive layer to a material selected from the group consisting of diborane, phosphine, and a carbon-silicon compound to reduce an ability of the conductive layer to associate with oxygen. The combination of elements recited in claim 73 is therefore allowable.

The claims dependent on the independent claims are allowable for the same reasons as the independent claims, and because of the additional limitations added by the dependent claims. Furthermore, dependent claim 75 recites the in-process device of claim 74, which recited the conductive layer being a tungsten nitride layer, wherein the in-process device further includes another conductive layer formed on the tungsten nitride layer. None of the prior art references of record, including Chien, discloses or suggests an in-process device having a conductive layer formed on a conductive layer that has been exposed to the materials recited in claim 73, and claim 75 is thus allowable for this additional reason. Neither does any of the references of record, including Chien, disclose or suggest exposing the conductive layer to the

carbon-silicon compounds recited in new claim 76, and thus claim 76 is allowable for this additional reason.

The specification has been amended to include a patent number corresponding to an application number set forth in the specification. This amendment adds no new matter.

The present patent application is in condition for allowance, and favorable consideration and a Notice of Allowance are respectfully requested. The Examiner is requested to contact the undersigned at the number listed below for a telephone interview if, upon consideration of this amendment, the Examiner determines any pending claims are not in condition for allowance. The undersigned also requests the Examiner to direct all future correspondence to the address set forth below in the event the Examiner shows a different correspondence address for the attorney of record.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned **"Version with Markings to Show Changes Made"**.

Respectfully submitted,
DORSEY & WHITNEY LLP

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PFR:asw

Enclosures:
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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Specification:

Paragraph beginning at line 4 of page 8 has been amended as follows:

Still other gases include diborane (B_2H_6); phosphine (PH_3); and carbon-silicon compounds such as methylsilane (CH_3SiH_3) and hexamethyldisilane $(CH_3)_3Si\text{-}Si(CH_3)_3$; and hexamethyldisilazane (HMDS). Additional alternate embodiments of the current invention use hydrazine (N_2H_4), monomethylhydrazine, carbon tetrafluoride (CF_4), CHF_3, HCl, and boron trichloride (BCl_3), which are also useful in passivating dielectrics, as addressed in copending application 09/114,847, now issued as U.S. Patent No. 6,201,276 B1. Also included are mixtures of any of the gases or types of gases described above. Exemplary non-plasma process parameters using these other gases include a flow rate of about 2 sccm to about 400 sccm for these gases; a flow rate of about 50 sccm to about 100 sccm for an inert carrier gas such as He or Ar; a temperature ranging from about 150 to about 600 degrees Celsius, a pressure ranging from about 50 millitorr to about 1 atmosphere (760 torr); and a process time ranging from about 50 to about 500 seconds. Again, one skilled in the art is aware that these parameters can be altered to achieve the same or a similar process.

In the Claims:

Claim 73 has been amended as follows:

73. (Twice Amended) An in-process device, comprising:

a substrate; and

a conductive layer over the substrate, the conductive layer being exposed to a [selection] material selected from the group consisting of diborane, phosphine, and a carbon-silicon compound [methylsilane, hexamethyldisilane, hexamethyldisilazane, HCL, boron trichloride, and combinations thereof] to reduce an ability of the conductive layer to associate with oxygen.